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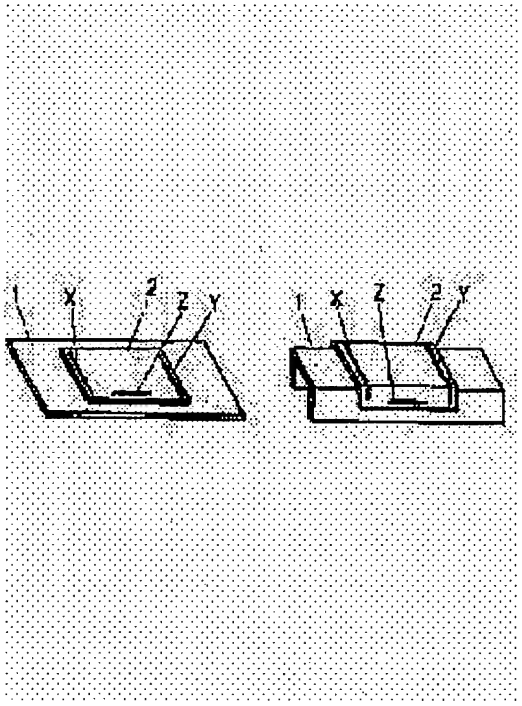
(54) BLANK FOR INTEGRALLY FORMING AND FORMING METHOD THEREOF

(57)Abstract:

PROBLEM TO BE SOLVED: To execute manufacture by simply clamping at the time of forming regardless of the accuracy of parts before joining by joining two or more metallic sheets in the vicinity of the profile line of a lapped part by line welding and joining at least one place in the vicinity of an opposite part to the weld zone on the profile line by line welding.

SOLUTION: In a blank for integrally forming before forming a Ushape, weld lines X-Z are provided on the slightly inside of the profile line of the metallic sheet B2. The weld line X and weld line Y are provided in the opposite positions on the profile line. At the time of forming, the weld lines X, Y are subjected shearing stress in the direction of the weld line between the metallic sheet A1 and the metallic sheet B2 and are balanced each other. In a use state, when load is applied from the upper part as a beam structure, for example, the weld lines X, Y are subjected to shearing stress to each other in the opposite direction in the lateral direction, so both weld lines are in a relation of opposed position. In such a case, it is not objectionable that there is no weld line in the opposite position of the weld line Z.



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TITLE: **Tailored blanks** for integrally forming pressed components for motor vehicles, are formed by joining profile line of two or more overlapped metal plates by welding

PATENT-ASSIGNEE: SUMITOMO METAL IND LTD[SUMQ]

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ABSTRACTED-PUB-NO: JP2000197969A

BASIC-ABSTRACT:

NOVELTY - Metal plates (1-3) are placed one above the other and joining of the profile line of the overlapping plates is carried out with welding.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for the shaping method of blanks.

USE - For manufacture of pressed components for motor vehicles e.g. chassis manufacture.

ADVANTAGE - A cheap **tailored blank** can be manufactured. The method enables joining non-linear materials and the component manufactured by this method has excellent corrosion resistance and can perform application as the covering components of motor vehicles.

DESCRIPTION OF DRAWING(S) - The figure shows welding position in the blank formation method.

Metal plates 1-3

CHOSEN-DRAWING: Dwg.7/11

TITLE-TERMS: TAILORED BLANK INTEGRAL FORMING PRESS COMPONENT MOTOR VEHICLE
FORMING JOIN PROFILE LINE TWO MORE OVERLAP METAL PLATE WELD

DERWENT-CLASS: P52 P55

SECONDARY-ACC-NO:
Non-CPI Secondary Accession Numbers: N2000-372808

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CLAIMS

[Claim(s)]
[Claim 1] The blank for unification shaping characterized by being combined by line welding near [with which the piled-up metal plate of two or more sheets lapped] the border line of a part, and being combined by at least one-place line welding near the part which counters this line weld zone on this border line.
[Claim 2] The blank for unification shaping according to claim 1 characterized by line welding being a fillet weld.
[Claim 3] The blank for unification shaping according to claim 1 or 2 characterized by there being no fusion zone of a line welding reason in the 1st [at least] page of the lateral surface of the piled-up metal plate.
[Claim 4] The unification shaping approach of the blank characterized by making into a die side the field which does not have the fusion zone of a line welding reason in the blank for unification shaping according to claim 3, and fabricating it in press forming performed using punch and a die.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the blank (tailored blank) technique for unification shaping mainly used for the pressing manufacture the body of an automobile, and for chassis.
[0002]
[Description of the Prior Art] The conventional press and the assembly technique of a press article were methods which cut the metal plate of one sheet in a predetermined configuration (this cut metal plate is called a blank), carry out press forming after that, assemble a press article by welding, adhesion, etc., and are used as the structure.
[0003] On the other hand, from the first stage of the 1960s, before carrying out press forming, some metal plates (blank) were compared, and the technique which makes the blank of one sheet and is pressed after that by laser welding or mush seam welding has spread. This technique is a tailor-made welding blank, and is called the "tailored blank."
[0004] There are many merits described below with this tailored blank technique.
(a) Conventionally, the small steel plate currently processed as a scrap can be connected by welding, it can use as a large-sized blank, and a deployment of an ingredient is attained.
[0005] (b) Conventionally, in order to compensate the lack of on the strength of a pressing, the reinforcement member was joined partially, but if a tailored blank is used, high intensity material or a thicker ingredient can be beforehand used for the location which needs reinforcement, reinforcement can be secured, and the cost of a reinforcement member can be reduced.
[0006] (c) The amount of the expensive ingredient (a high-tensile-steel plate, surface treated steel sheet) used is stopped, and the cost of materialses can be reduced. Moreover, it leads also to lightweight-ization of a car body.
[0007] (d) A predetermined load member can be arranged and the design of the components and a car body excellent in collision safety becomes [the car-body deformation optimal at the time of the collision of an automobile] possible so that may be acquired.
[0008] Drawing 1 is the mimetic diagram showing the welding method of the tailored blank by the butt weld put in practical use, and is this drawing (a). Laser welding and this drawing (b) It is the case of mush seam welding. In this drawing, the signs 1 of a metal plate A and 2 are [a metal plate B and 4] weld zones. Usually, a basic metal plate [metal plate / A] and metal plates B are additional metal plates, such as reinforcing materials. In addition to this, a welding method also has electron beam welding, arc welding, and high-frequency-heating welding.
[0009] This drawing (a) It is the approach of seizing on a laser-welding method, it making the metal plate of two sheets suit, and carrying out melting welding with carbon dioxide gas laser or Nd-YAG laser beam.
[0010] This drawing (b) Mush seam welding is the approach of joining, while carrying out energization heating, pressurizing the metal plate edge sections with a rotating disk electrode in piles about 2mm and crushing the heavy section. In addition, although the plate edge section is slightly piled up in mush seam

welding, most metal plates are not the blanks which carried out line welding of the piled-up metal plate as used in the field of [do not lap and] this invention. That is, the example of this drawing is not a lap welding, seize on it, is made to suit and is classified as welding.
[0011] While it pokes, and it is made to suit and there are many advantages in the tailored blank by welding, there are also the following troubles.
[0012] (a) Butt welding by laser welding requires the cutting precision of the edge of the plate joined, and the positioning accuracy of a laser beam. Many defectives will be generated if this precision is not enough. Therefore, it is necessary to use expensive equipment for cutting equipment and the pointing device at the time of welding.
[0013] On the other hand, the clamp device in which heavy cost tends to shift and mush seam welding has the powerful clamp force in order to carry out the load of the welding pressure of about 1t with an electrode, although as severe edge profile irregularity as laser welding is not required is needed. For this reason, expensive equipment is required although it is not laser welding.
[0014] (b) If components with which a weld zone becomes nonlinear are joined, the design degree of freedom of a pressing can pull out the advantage of a breadth tailored blank to the maximum extent. However, since a rotating disk electrode is used in mush seam welding, nonlinear welding is very difficult or impossible. moreover -- although nonlinear welding is possible in laser welding -- the above (a) It is markedly alike, and becomes difficult and a technical and cost-problem to utilization is more difficult than the case where the described groove accuracy management is straight-line welding.
[0015] (c) Since the weld line exists in the components after a press, appearance is bad and cannot apply to the shell plate components of the automobile body. Moreover, application is difficult for a weld zone on the components as which corrosion resistance is inferior and high corrosion resistance is required. To apply to the part to which corrosion resistance is demanded, it is necessary to paint thickly or to take the cure of protecting with the sealer after paint.
[0016] That the above-mentioned problem should be solved, the steel plate of two sheets is piled up, and after carrying out spot welding of a large number in respect of [overlapping] the, the technique which carries out press forming is indicated by reference (The Patchwork Techniqu For ProperMaterial Placement on Panels:Industrial Application on The New Peugeot 206.IBEC'98 Paper No.982402).
[0017] Drawing 2 is the mimetic diagram really by the spot welding of a large number indicated by reference showing the outline of the weld zone of the blank for shaping. The same components as drawing 1 express with the same sign in this drawing. As shown in this drawing, the approach indicated by this reference is a method which performs much spot welding in the superposition section. Since this approach has the unnecessary groove management with a high precision compared with the tailored blank of the comparison method by conventional laser welding and mush seam welding, a positioning clamp is easy and it is manufactured by the cheap spot welding method, a tailored blank can be manufactured by low cost. Moreover, the point which can be manufactured even when a matching section end face is nonlinear is also the advantage.
[0018] However, the point junction by spot welding is a base, the technique started by this reference requires a big load for a weld zone at the time of press forming, and defects, such as a wrinkling and a crack, tend to generate it near the weld zone. Moreover, since it is point junction, the mechanical property (static reinforcement, fatigue strength, rigidity) of the member after pressing etc. is not enough. Furthermore, since it is the welding process which piles up the edge of the steel plate of two sheets, a coating turns to the clearance between steel plates, and it is hard to be crowded, and since it is easy to produce corrosion also in clearance, there is a problem that corrosion resistance is inferior.
[0019] Furthermore, the above (c) The problem of appearance quality is unsolvable also by this approach. That is, since it is spot welding, the indentation by the RBI is formed and both sides cannot be applied to a shell plate. Moreover, a possibility that corrosion may occur from an indentation section front face after paint is also high.
[0020]
[Problem(s) to be Solved by the Invention] This invention is for the purpose to offer the blank which fills the following demand, and its manufacture approach, without spoiling the advantage which the

conventional tailored blank has.
[0021] (a) The precision of a junction anterior part article is not required, but it can manufacture by the easy clamp at the time of shaping.
(b) Even if the edge of a junction anterior part article is nonlinear, it can manufacture.
(c) The strength property of the components after shaping and corrosion resistance are excellent.
(d) It has the surface quality in which application to a shell plate is possible.
[0022]
[Means for Solving the Problem] In order to realize the above-mentioned purpose, the artificer acquired the following knowledge, as a result of repeating examination wholeheartedly.
[0023] (a) Spot welding is inadequate for combining metal plates in reinforcement, and a moldability is also low. Moreover, corrosion resistance is not good.
[0024] Drawing 3 is a mimetic diagram explaining the comparison of spot welding and line welding, and is this drawing (a). The side elevation of the piece of a spot welding trial, and this drawing (b) The side elevation of the piece of a trial of line welding, and this drawing (c) It is the mimetic diagram of the press crack in line welding. In this drawing, the same components as drawing 1 -2 express with the same sign. the ingredient of the piece of a trial -- cold rolled sheet steel (0.8mm and 1.2mm) (SPCC) -- using -- this drawing (a) And (b) it is shown -- as -- a partial pile method -- spot welding (the diameter of a nugget: about 4mm) -- and laser welding was carried out and the piece of a trial was created. The moldability was investigated for these blanks by overhang trial using spherical punch with a diameter of 50mm. Consequently, the fibrinogenolysis tie by laser welding is this drawing (c). The spot-welding material by spot welding was fractured by the weld zone to having fractured within the 0.8mm base material so that it might be shown (not shown). Moreover, it turned out that marginal overhang height is 10mm in about 35mm and spot welding material, and the direction of line welding is excellent in a moldability in laser-welding material.
[0025] Moreover, since there is no flapping of a metal plate like spot welding, since line welding can prevent invasion of water etc., corrosion resistance is high [welding / its clearance between metal plates is small, and]. If especially a fillet weld is performed, the clearance between metal plates will be lost and corrosion resistance will improve further.
[0026] (b) Although the weld line of seam welding has a straight-line-like limit, if laser welding is used, curve-izing will be possible and the degree of freedom of components plate junction will become large.
[0027] (c) If the metal plate of two or more sheets is not compared, but it welds superposition and near the border line of the overlapping part in a field and a metal plate is combined, the precision of blanking processing of a welding anterior part article and the positioning accuracy of welding do not need to be so high. It is seldom necessary to also enlarge holding power at the time of a clamp.
[0028] Line welding is good to carry out line welding continuously over the perimeter (periphery) of the border line of the overlapping part. It may be partial and intermittent although it is because welding reinforcement is securable. However, if line welding is not carried out in the location (part countered on a border line) which corresponds on the diagonal line when line welding of near the border-line top is carried out partially and intermittently, a shear gap of the metal plate of two sheets will become large at the time of shaping or use.
[0029] Although seam welding is impossible when a border line is nonlinear, cheap seam welding can be used maintaining reinforcement by carrying out the seam welding only of the short straight-line part, and carrying out the seam welding also of the opposite part on the border line of the part with which the metal plate lapped further.
[0030] (d) If the reinforcement member of one sheet is piled up inside the metal plate which forms an appearance, the metal plate which forms an appearance can really be fabricated as an object. This is excellent in appearance nature as compared with the blank which carried out the butt weld. If it is made for the melting marks of line welding not to come outside especially, the further excellent appearance will be acquired.
[0031] what was completed based on the knowledge of the above [this invention] -- it is -- (1) of the following [summary / the] from -- (4) It is.

[0032] (1) The blank for unification shaping characterized by being combined by line welding near [with which the piled-up metal plate of two or more sheets lapped] the border line of a part, and being combined by at least one-place line welding near the part which counters this line weld zone on this border line.
[0033] (2) The above characterized by line welding being a fillet weld (1) Blank for unification shaping given in a term.
[0034] (3) The above characterized by there being no fusion zone of a line welding reason in the 1st [at least] page of the lateral surface of the piled-up metal plate (1) Or (2) Blank for unification shaping given in a term.
[0035] (4) Set to press forming performed using punch and a die, and it is the above (3). The unification shaping approach of the blank characterized by making into a die side the field which does not have the fusion zone of a line welding reason in a term in the blank for unification shaping of a publication, and fabricating it.
[0036] With the condition here, the metal plate of two sheets said to this invention "has lapped" Drawing 1 (b) It is not in the condition that the metal plate of two sheets has lapped with the line only near the weld line like mush seam welding. The border line with which the part which metal plates have lapped in the shape of a field over the part or all the range of a fabricated field, and lapped spread two-dimensional is formed, and it means that it is what is fabricated by one while it has been in the condition which these metal plates overlapped at the time of press forming. Moreover, in the case of simple configurations, such as a regular polygon and a rectangle, the border line of "the part on this border line that counters this line weld zone" is a part on the diagonal line. In a common graphic form, the shearing stress which acts between the metal plates which lapped while using [shaping and/or] shaping components corresponds to a certain weld-line part, and the part which has the relation with which both sides balance in hard flow mutually is said so that it may mention later by explanation of drawing 7 .
[0037]
[Embodiment of the Invention] The blank for one shaping of this invention is joined by line welding near the border line of the part which the metal plate of two or more sheets piled up, and lapped, and the part which this line weld on this border line counters is also joined by line welding.
[0038] It is because a load concentrates on a welding point that welding is spot welding like spot welding at the time of shaping and it becomes easy to produce a crack. Moreover, even if it can fabricate, dispersion of a member on the strength is large, and dependability falls. Although the load load per point will become small and the above problems will improve if the number of RBIs of spot welding increases, it is inefficient-on construction-like that the number of RBIs increases.
[0039] Drawing 4 is this drawing (a) at the mimetic diagram showing the condition near the weld zone of the blank concerning this invention. In the case of the fillet lap welding by laser welding or arc welding, it is this drawing (b). In the case of the lap welding with ** by laser welding or arc welding, it is this drawing (c). It is the case of the lap welding with ** by seam welding. In this drawing, the same components as drawing 1 -3 express with the same sign. moreover -- detail explanation of this invention -- drawing 4 (b) And (c) the case where the inside of the border line of a part with which the metal plate lapped is welded like -- "generation -- with -- it is called" welding.
[0040] This drawing (a) Although it is necessary to make precision of cutting and blanking high in the case of a fillet lap welding [like], and to make precision of welding positioning high, easy equipment is sufficient as clamp equipment, and it has the advantage (after-mentioned) of corrosion-resistant improvement.
[0041] On the other hand, it is this drawing (b). Or (c) Like, as welding with **, if approved in the range whose width of face W shown in this drawing is 3-10mm, the precision of cutting and blanking and welding positioning accuracy are so high, it is not necessary to carry out, and clamp equipment can also be manufactured with easy equipment.
[0042] Drawing 5 is the mimetic diagram showing how to pile up the metal plate of the ingredient of the blank concerning this invention, and is this drawing (a). A perfect pile method and this drawing (b) A partial pile method and this drawing (c) It is the case of an end-face **** pile method. In this drawing,

the same components as drawing 1 -4 express with the same sign.
[0043] The heavy method of this invention is this drawing (a). - (c) Any are sufficient. This drawing (a) By the shown perfect pile method, one of metal plates is completely in contact with other metal plates. In the thing aiming at partial reinforcement of autoparts, this method is the most common.
[0044] This drawing (b) The surface width 5 of a lap part has the breadth as two-dimensional, and a metal plate A1 and metal plate B-2 are fabricated by the partial pile method by coincidence. although the surface width 5 of a lap part may have a narrow part partially -- all parts -- being narrow (for example, less than 5mm) -- substantial -- butt welding -- becoming -- this invention -- being out of range . This drawing (b) When it becomes press-forming components, since one of heavy lines comes out outside, the partial pile method of the metal plate of two sheets is not suitable for the components for sheathing.
[0045] This drawing (c) Since the positioning accuracy with which an end-face **** pile method arranges cutting, the blanking precision, and the end face of a welding anterior part article, and the aim precision of welding are required, the advantage of this invention is lost a little.
[0046] Drawing 6 is the mimetic diagram showing various kinds of conditions which the metal plate of three sheets piles up, and is this drawing (a). The perfect pile and said drawing (b) A partial pile and this drawing (c) It is the case of an end-face **** pile. In this drawing, the same components as drawing 1 -5 express with the same sign. A sign 3 is a metal plate C and is equivalent to the addition material for reinforcing further the configuration of the metal plate of the two-sheet pile of drawing 5 .
[0047] As shown in this drawing, in this invention, three sheets or more than it may be joined for the metal plate. Moreover, in the blank of this invention, a perfect pile and partial pile and an end-face **** pile may be intermingled.
[0048] Line welding of the blank for one shaping of this invention is carried out near [with which the metal plate lapped] the border line of a part, and at least one place is combined by line welding near the part on this border line that counters this line weld zone.
[0049] If the location of line welding where it counters on a border line is welded in the location, welding locations with which the shearing stress between the metal plates added while using [shaping of a blank and/or] a said division article balances will be said.
[0050] Drawing 7 is the mimetic diagram which illustrated the fibrinogenolysis contact position in the unification shaping blank of this invention. This drawing (a-1) The blank for unification shaping before character shaping of KO, and this drawing (a-2) What fabricated this, This drawing (b-1) The blank for unification shaping before stretch forming and this drawing (b-2) are the thing and this drawing (c-1) which fabricated this. The blank for unification shaping before extrusion molding from which the configuration of the metal plate B used as the back up plate became C character type, and this drawing (c-2) This is fabricated. The same components as drawing 1 express with the same sign in this drawing. The weld line which has the relation which counters mutually on the border line of this invention is explained using this drawing.
[0051] drawing 7 (a-1) setting -- weld-line X-Z -- the border line of metal plate B-2 -- it is inside a little. The weld line X and the weld line Y are in the location which countered on the border line. That is, as shown in this drawing (a-2), when fabricating, although the weld lines X and Y receive the shearing stress of the direction of the weld line between metal plates, they balance mutually. In a busy condition, when receiving the load which receives a load from the upper part of this drawing (a-2) as beam structure, in order that the weld lines X and Y may receive the shearing stress of hard flow in this drawing longitudinal direction mutually, both the weld lines are in the physical relationship which countered. However, this drawing (a-1) The weld line Z does not have the weld line in the location which counters. the blank for unification shaping of this invention -- if -- since it is making to be combined by at least one-place line welding in the location which counters into requirements -- this drawing (a-1) The blank for unification shaping also belongs to this invention range. However, if it is only the weld line of Y and Z, the requirements for this invention will not be satisfied.
[0052] Drawing 7 (b-1), the weld lines X and Y by which the fillet weld was carried out countered, and the weld lines R and S have countered. This drawing (b-2) In order to carry out stretch forming like, it is because it is because it is desirable to form the weld line which set the object shaft as the core of disc-

like reinforcing materials's metal plate B-2.
[0053] drawing 7 (c-1) **** -- the weld lines Y and Z have countered to the weld line X. Moreover, to the weld line R, it can be said that the weld line S and the weld line T have countered. Namely, a number does not necessarily correspond by 1:1 and, as for the weld line which counters, the part which the load of the shearing stress of hard flow is mutually carried out at the time of shaping and/or use, and balances may have the opposite relation of 1:plurality. Although the weld-line die length of the weld lines which counter does not need to be equal, the difference or ratio of weld-line die length is less than **20%, and it is desirable to make it equal.
[0054] In the blank for unification shaping of this invention, the location of line welding is carried out near the border line of a metal plate. A fillet weld is welded on a border line. It is heavy laser welding, lap seam welding, etc., and when taking welding width-of-face cost, it is usually the part of less than 10mm of insides near the border line.
[0055] The die length of the weld line is so desirable that it is long. Since the minimum die length changes with the configuration of a joint, and forming behaviors at the time of a press, it cannot generally decide, but in the trial which artificers performed, if the weld length has the 50% or more of the die length of a border line, fracture by the weld zone has not broken out. As for the die length of this to the weld line, it is desirable to secure 50% or more of die length of the die length of the border line of the overlapping part. Moreover, it is desirable to consider as 50% or more of die length of the perimeter die length of the metal plate piled up by the perfect pile method.
[0056] The one continuous weld line may be used for line welding, and the intermittent weld line may be used for it. That is, the case where at least the one 100mm weld lines [ten] have the 10mm weld line is sufficient as all welding length in 100mm. However, when the weld line is intermittent, a surroundings lump of the coating to a non-weld is bad, and the weld line which continued since there was a possibility that it might pile up and corrosion might spread from the interior of a field when water permeated is more desirable.
[0057] In this invention, if the locations which counter have the weld line, in addition even if there are spot welding and line welding, it will not interfere. Line welding or spot welding may be additionally performed in the center section in a border line for reinforcement.
[0058] if the welding process at the time of manufacturing the blank of this invention is line welding -- what kind of approach -- ****** -- resistance welding and melting welding -- which welding process may be used. The lap seam welding using the disc electrode as resistance welding is raised. As melting welding, they are metal active gas arc welding and gas shield metal arc welding like carbon-dioxide-gas welding. Gas shielded arc welding like TIG-arc-welding plasma arc welding. Moreover, laser beam welding and electron beam welding are raised.
[0059] Although it is possible to acquire surface quality also with good resistance welding like lap seam welding in the blank of this invention, since an electrode contacts ingredient both sides, the trace by the electrode may remain.
[0060] In order to obtain a good front face, it is desirable to weld in melting welding process on the conditions (conditions of not penetrating) which the inferior surface of tongue (rear face) of the metal plate of the opposite side (below) of a heat input side does not fuse. Although the discoloration called the temper color by the thermal effect will produce a rear-face side a little if it welds on the conditions which a rear face does not fuse by melting welding, as for after paint, the trace of welding does not appear at all.
[0061] If this inferior-surface-of-tongue side is made into the outside of shaping components, it is applicable also to automobile shell plate components. Generally, since the sheathing side of a shell plate is on the die side of metal mold, the shaping approach in this invention is good to use the die side of metal mold as the rear face of a blank.
[0062] Although especially the magnitude of penetration is not limited, in order to obtain healthy joint reinforcement and to avoid melting on the back, it is thought desirable to aim at about 25 - 75% of penetration depth of the board thickness by the side of a rear face (inferior lamella).
[0063] By laser welding of cold rolled sheet steel, as for such a welding condition, the condition that

there is [steel plate thickness of two sheets] no fusion zone in penetration and an inferior surface of tongue in about 25 - 75% of board thickness of 0.4-6.0mm (preferably 0.6-3.0mm), 1-10kW of carbon-dioxide-gas laser outputs, the 0.01-1mm speed of travel 1 of diameters of a focus - 10 m/min, then a bottom steel plate is acquired.

[0064] It is desirable to use a fillet lap welding for making the advantage of the blank of this invention into max. Drawing 4 (b) Or (c) When there is a welding margin like the shown lap welding with **, there is risk of damaging the metal mold of press forming in the edge section. Moreover, a paint film cannot ride easily and corrosion resistance is inferior in the edge section. Furthermore, it is because a coating is hard turning to the clearance between metal plates and the corrosion resistance of the clearance section is also inferior. Furthermore, the contribution of a welding margin to the reinforcement of a member is small, and it also has the bad influence of the increment in weight.

[0065] On the other hand, a fillet lap welding is drawing 3 (a). It is the approach of welding the edge of the metal plate piled up so that it might be shown. In a fillet weld, the end face of a metal plate fuses, and other metal plates which touch this are fused and joined. At the time of press forming, since it is usually below the thickness of the original metal plate, and climax of the weld zone of a fillet weld cannot attach a crack to metal mold easily, it is desirable. Or in the case of metal active gas arc welding or TIG arc welding, a weld metal is supplied along with the border line of a metal plate, and both metal plates are joined. Since the metal supplied depending on the welding condition rises more than the thickness of a metal plate, metal mold is damaged or an indentation is brought to mold goods, special attention is required. It is desirable to weld on the conditions which a rear face does not fuse in a fillet lap welding.

[0066]

[Example] (Example 1) The blank by butt welding of the conventional method using carbon-dioxide-gas laser welding and the blank by the lap welding of this invention were made as an experiment to a large number, and the percent defective was investigated.

[0067] Drawing 8 is the schematic diagram showing the configuration of the test piece of this example 1, and is this drawing (a). A top view and this drawing (b) The side elevation in the case of the conventional example, and this drawing (b) It is a side elevation in the case of the example of this invention. In this drawing, the same components as drawing 1 -6 express with the same sign. This drawing (a) The test piece of the conventional example carried out butt welding of the cold rolled sheet steel (0.8mm and 1.6mm) so that it might be shown. A cutting plane is a field cut by the shirring machine.

[0068] On the other hand, it is this drawing (b). The blank by the lap welding of the example of this invention piled up 0.8mm cold rolled sheet steel on 0.8mm cold rolled sheet steel, and carried out the fillet weld of the heavy section so that it might be shown. All, a welding condition is 3kW in output, and the speed of travel is 5 m/min.

[0069] 100 test pieces of the example of this invention and the conventional example were created, respectively, appearance observation of the weld zone was carried out, and the number of defectives was investigated.

[0070] Drawing 9 is the mimetic diagram showing the appearance of the laser-welding result of a test piece, and is this drawing (a). In the case of the defect of a butt weld non-constructed a bridge, it is this drawing (b). It is this drawing (c) the case of the poor undercut of a butt weld. In the case of the excellent article of a butt weld, it is this drawing (d). It is the case of the excellent article of a lap welding. This drawing (a) Un-constructing a bridge and this drawing (b) The undercut was counted as a defect.

[0071] the result of a weld examination -- the blank of the conventional example -- if -- 37% of undercut and 6% of un-constructing a bridge arose. On the other hand, there was no generating of a defect in the example of this invention.

[0072] (Example 2) The weld examination with the nonlinear weld line of a blank was performed. Drawing 10 is the schematic diagram showing the configuration of a test piece with the circle-like weld line, and is this drawing (a). A top view and this drawing (b) The side elevation in the case of the butt

weld of the conventional example, and this drawing (c) It is a side elevation in the case of the lap welding of the example of this invention. The same components as drawing 1 express with the same sign in this drawing.

[0073] this drawing (a) in the cold rolled sheet steel of 0.8mm and 1.6mm thickness, the test piece of the conventional example pierces disc-like metal plate B-2 by punch, and has opening so that it may be shown -- it welded by inserting in metal plate A1.

[0074] The test piece of the example of this invention piled up and carried out the fillet weld of disc-like metal plate B-2 of 0.8mm thickness to the metal plate A1 of the cold rolled sheet steel of 0.8mm thickness. After the conventional example and the example of this invention set the location for the ingredient with the positioning jig, they moved NC table circularly and performed circle welding. The welding condition is the same as an example 1. Ten of these test pieces were created, respectively.

[0075] In the example of invention, there was no generating of a defect to all ten undercuts having been generated in the example of a comparison as a result of a weld examination.

[0076] (Example 3) Next, the corrosion resistance of a blank was investigated. Drawing 11 is the schematic diagram showing the configuration of the test piece for corrosion tests, and is this drawing (a). The side elevation in the case of butt welding by laser welding of the conventional example, This drawing (b) The side elevation in the case of the lap welding by the spot welding of the conventional example, This drawing (c) It is a side elevation in the case of the lap welding by laser welding of the example of this invention. This drawing (c-1) A side elevation when the fusion zone has penetrated by the lap welding with **, and this drawing (c-2) A side elevation when the fusion zone has penetrated by the fillet lap welding, and this drawing (c-3) A fillet lap welding shows the side elevation in not penetrating. 20-micrometer electropainting is given to these test pieces, and it is salt spray test ****** of a front face and a rear face. Corrosion resistance evaluation rusted and made time amount (days) to generating the index. A test result is shown in Table 1.

[0077] As shown in this table, in test piece No.1 (equivalent to a butt weld and drawing 11 (a)) of the conventional example, corrosion generated the surface (welding-heat-input side) rear face in the weld zone. Since the weld zone has not removed the oxide completely, the adhesion of a coating coat is lowered for the oxide by welding reason, and it is thought that corrosion resistance deteriorated. In the case of test piece No.2 (spot welding,: drawing 11 R> 1 (b)), the end face of superposition corroded for a short time, and rust was generated also between the piled-up steel plates. It is thought by the clearance that it degraded the circumference ****** corrosion resistance of a coating. Generation with laser-welding penetration, Drawing 11 (c-1) :: Although test piece No.3 were an example of this invention, they corroded the front face like test piece No.2 for a short time. The conditions of a surface edge are because it is equivalent to No.2. Test piece No.4 are laser fillet-weld penetration (drawing (c-2)), and surface corrosion resistance is better than No.1-3. The fusion zone on the back had oxidized in response to the thermal effect, and although corrosion resistance was superior to No.3 a little, it was not enough. Although test piece No.5 were not laser fillet-weld penetrated (drawing (c-3)) and the corrosion resistance of a surface weld zone was equivalent to No.4, since a rear face did not have a fusion zone by welding, its corrosion resistance was very good.

[0078]

[Table 1]

試験番号	溶接方法	さび発生日数（腐食個所）		備考
		表面	裏面	
1	突合わせレーザ溶接	5日（溶接部）	6日（溶接部）	従来例
2	スポット抵抗溶接	1日（端面）	7日（溶接部）	従来例
3	代つき重ねレーザ溶接（貫通）	1日（端面）	7日（溶接部）	本発明例
4	すみ肉重ねレーザ溶接（貫通）	10日（溶接部）	10日（溶接部）	本発明例
5	すみ肉重ねレーザ溶接（非貫通）	10日（溶接部）	100日以上さび発生なし	本発明例

[0079]
[Effect of the Invention] A cheap tailored blank can be manufactured by this invention, and a cutting plane line can apply also to a nonlinear ingredient. Furthermore, the mold goods obtained with the application of this invention are excellent also in corrosion resistance and appearance nature, and application on the sheathing-material components for automobiles is possible for them.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the mimetic diagram showing the welding method of the tailored blank by the butt weld, and is this drawing (a). Laser welding and this drawing (b) It is the case of mush seam welding.
[Drawing 2] It is the mimetic diagram really by spot welding showing the outline of the weld zone of the blank for shaping.
[Drawing 3] It is a mimetic diagram explaining the comparison of spot welding and line welding, and is this drawing (a). The side elevation of the piece of a spot welding trial, and this drawing (b) The side elevation of the piece of a trial of line welding, and this drawing (c) It is the mimetic diagram of the press crack in line welding.
[Drawing 4] It is this drawing (a) at the mimetic diagram showing the condition near the weld zone of the blank concerning this invention. In the case of the fillet lap welding by laser welding or arc welding, it is this drawing (b). In the case of the lap welding with ** by laser welding or arc welding, it is this drawing (c). It is the case of the lap welding with ** by seam welding.
[Drawing 5] It is the mimetic diagram showing how to pile up the metal plate of the ingredient of the blank concerning this invention, and is this drawing (a). A perfect pile method and this drawing (b) A partial pile method and this drawing (c) It is an end-face **** pile method case.
[Drawing 6] It is the mimetic diagram showing various kinds of conditions which the metal plate of three sheets piles up, and is this drawing (a). The perfect pile and said drawing (b) A partial pile and this drawing (c) It is the case of an end-face **** pile.
[Drawing 7] It is the mimetic diagram which illustrated the fibrinogenolysis contact position in the unification shaping blank of this invention. This drawing (a-1) The blank for unification shaping before character shaping of KO, and this drawing (a-2) What fabricated this, This drawing (b-1) The blank for unification shaping before stretch forming, and this drawing (b-2) The thing and this drawing (c-1) which fabricated this The blank for unification shaping before extrusion molding from which the configuration of the metal plate B used as the back up plate became C character type, and this drawing (c-2) This is fabricated.
[Drawing 8] It is the schematic diagram showing the configuration of a test piece, and is this drawing (a). A top view and this drawing (b) The side elevation in the case of the conventional example, and this drawing (b) It is a side elevation in the case of the example of this invention.
[Drawing 9] It is the mimetic diagram showing the appearance of the laser-welding result of a test piece, and is this drawing (a). In the case of the defect of a butt weld non-constructed a bridge, it is this drawing (b). It is this drawing (c) the case of the poor undercut of a butt weld. In the case of the excellent article of a butt weld, it is this drawing (d). It is the case of the excellent article of a lap welding.
[Drawing 10] It is the schematic diagram showing the configuration of a test piece with the circle-like weld line, and is this drawing (a). A top view and this drawing (b) In the case of the butt weld of the conventional example, they are a side elevation and this drawing (c). It is a side elevation in the case of the lap welding of the example of this invention.

[Drawing 11] It is the schematic diagram showing the configuration of the test piece for corrosion tests, and is this drawing (a). The side elevation in the case of butt welding by laser welding of the conventional example, This drawing (b) The side elevation in the case of the spot welding lap welding of the conventional example, and this drawing (c) It is a side elevation in the case of the lap welding by laser welding of the example of this invention. This drawing (c-1) A side elevation when the fusion zone has penetrated by the lap welding with **, and this drawing (c-2) A side elevation when the fusion zone has penetrated by the fillet lap welding, and this drawing (c-3) A fillet lap welding shows the side elevation in not penetrating.

[Description of Notations]

1: Metal plate A 2: Metal plate B

3: Metal plate C 4: Weld zone

5: Surface width of a lap part

[Translation done.]

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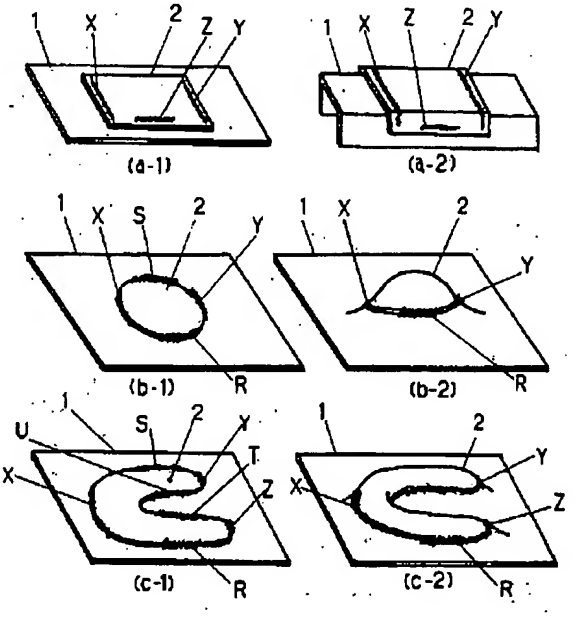
(54)【発明の名称】　一体化成形用ブランクおよびその成形方法

(57)【要約】
【課題】　接合前部品の精度が要求されず、安価な部品の固定装置および安価でかつ非直線溶接線も処理可能な溶接個所の位置決め装置で、成形後の部品の強度特性、耐食性が優れ、自動車用外装部品への適用が可能な一体成形用ブランクおよびその製造方法を提供する。
【解決手段】　２枚以上の金属板を重ね、重なった部分の輪郭線近傍を線溶接で結合し、さらに該線溶接部の該輪郭線上の対向する部分にも線溶接する。すみ肉溶接で線溶接するとなおよい。外側の少なくとも１面に線溶接起因の溶融部がないとさらによい。



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【特許請求の範囲】

【請求項1】　重ねられた2枚以上の金属板が、重なった部分の輪郭線の近傍で線溶接によって結合され、該輪郭線上の該線溶接部に対向する部分の近傍で少なくとも1個所線溶接によって結合されていることを特徴とする一体化成形用ブランク。

【請求項2】　線溶接がすみ肉溶接であることを特徴とする請求項1に記載の一体化成形用ブランク。

【請求項3】　重ねられた金属板の外側面の少なくとも1面に線溶接起因の溶融部がないことを特徴とする請求項1または2に記載の一体化成形用ブランク。

【請求項4】　ポンチおよびダイを用いて行うプレス成形において、請求項3に記載の一体化成形用ブランクを、線溶接起因の溶融部のない面をダイ側にして成形することを特徴とするブランクの一体化成形方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は主に自動車のボディやシャシー用のプレス部品製造に利用される一体化成形用ブランク（テーラードブランク）技術に関する。

【0002】

【従来の技術】従来のプレスおよびプレス品の組立技術は、一枚の金属板を所定の形状に切断し（この切断した金属板はブランクと呼ばれる）、その後、プレス成形し、プレス品を溶接・接着等で組み立てて構造物とする方式であった。

【0003】これに対し、1960年代初期から、プレス成形する前にいくつかの金属板（ブランク）を突き合わせ、レーザ溶接やマッシュシーム溶接によって1枚のブランクとし、その後プレスする技術が普及してきた。この技術は、テーラーメイドの溶接ブランクということで、「テーラードブランク」と呼ばれている。

【0004】このテーラードブランク技術では以下に述べる多くのメリットがある。

(a) 従来、スクラップとして処理されていた小型の鋼板を溶接によりつなぎ合わせて大型のブランクとして用いることができ、材料の有効利用が可能になる。

【0005】(b) 従来はプレス部品の強度不足を補うために、部分的に補強部材を接合していたが、テーラードブランクを用いればあらかじめ強度が必要な場所に高強度材またはより厚い材料を用いて強度が確保でき、補強部材のコストを削減できる。

【0006】(c) 高価な材料（高張力鋼板、表面処理鋼板）の使用量が抑えられ、材料費を削減できる。また、車体の軽量化にもつながる。

【0007】(d) 自動車の衝突時に最適な車体変形が得られるよう、所定の強度部材を配置することができ、衝突安全性に優れた部品や車体の設計が可能になる。

【0008】図1は実用化されている突合わせ溶接によるテーラードブランクの溶接方式を示す模式図であり同

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図(a) はレーザ溶接、同図(b) はマッシュシーム溶接の場合である。同図において、符号1は金属板A、2は金属板B、4は溶接部である。通常、金属板Aが基本となる金属板、金属板Bが補強材などの付加的金属板である。溶接方式にはこの他電子ビーム溶接、アーク溶接、高周波加熱溶接もある。

【0009】同図(a) のレーザ溶接法は2枚の金属板を突きあわせ、炭酸ガスレーザやNd-YAGレーザビームで溶融溶接する方法である。

【0010】同図(b) のマッシュシーム溶接は金属板端部同士を2mm程度重ねて、回転円盤電極で加圧しながら通電加熱し、重ね部をつぶしながら接合する方法である。なお、マッシュシーム溶接では板端部をわずかに重ねるものの、金属板の大部分は重なっておらず、本発明でいう重ねられた金属板を線溶接したブランクではない。すなわち、同図の例は重ね溶接ではなく、突きあわせ溶接として分類される。

【0011】突きあわせ溶接によるテーラードブランクには多くの長所がある反面、以下の問題点もある。

【0012】(a) レーザ溶接による突き合わせ溶接では、接合される板の端部の切断精度およびレーザビームの位置決め精度が要求される。この精度が十分でないと、不良品が多く発生する。そのため、切断装置、溶接時の位置決め装置には高価な装置を用いる必要がある。

【0013】一方、マッシュシーム溶接はレーザ溶接ほど厳しい端面精度が要求されないが、電極により1トン程度の加圧力を負荷するため、重ね代がずれやすく、強力なクランプ力を有するクランプ機構が必要になる。このためレーザ溶接ほどではないが、高価な装置が必要である。

【0014】(b) 溶接部が非直線となるような部品を接合するとプレス部品の設計自由度が広がりテーラードブランクの利点を最大限に引き出すことができる。しかし、マッシュシーム溶接では回転円盤電極を用いるため非直線溶接が極めて困難または不可能である。また、レーザ溶接では非直線溶接が可能ではあるが、前記(a) に述べた開先精度管理が直線溶接の場合より格段に難しくなり、技術的、コスト的な問題から実用化は難しい。

【0015】(c) プレス後の部品に溶接線が存在するために、見栄えが悪く、自動車ボディの外板部品には適用できない。また、溶接部は耐食性が劣り、高耐食性が要求される部品には適用が難しい。耐食性が要求される部位に適用する場合は、厚く塗装を施したり、塗装後シーラーで保護するなどの対策を講じる必要がある。

【0016】上記の問題を解決すべく、2枚の鋼板を重ね、その重なった面で多数スポット溶接した後にプレス成形する技術が文献（ The Patchwork Techniqu For ProperMaterial Placement on Panels : Industrial Application on The New Peugeot 206.IBEC'98 Paper No.982402 ）に開示されている。

【００１７】図２は文献に開示された多数のスポット溶接による一体成形用ブランクの溶接部の概要を示す模式図である。同図において図１と同一部品は同一符号で表す。同図に示すように、同文献に開示された方法は、重ね合わせ部に多数のスポット溶接を行う方式である。この方法は従来のレーザ溶接やマッシュシーム溶接による突き合わせ方式のテーラードブランクに比べ、精度の高い開先管理が不要で、位置決めクランプが簡単であり、安価なスポット溶接法で製造されるため、低コストでテーラードブランクが製造可能である。また、突合わせ部端面が非直線の場合でも製造可能である点も長所である。

【００１８】しかし、同文献に開始された技術はスポット溶接による点接合が基本であり、プレス成形時に溶接部に大きな負荷がかかり、溶接部近傍でしわ、割れなどの不良が発生しやすい。また、点接合であるためにプレス後の部材の機械的性質（静的強度、疲労強度、剛性）などが十分でない。さらに、２枚の鋼板の端部を重ねる溶接方法であるために、鋼板のすきまに塗料がまわりこみにくく、すきま内でも腐食が生じやすいため耐食性が劣るという問題がある。

【００１９】さらに、上記(c) の外観品質の問題はこの方法によっても解決できない。すなわち、スポット溶接であるため、両面とも打点による圧痕が形成され、外板には適用できない。また、塗装後においても圧痕部表面から腐食が発生する恐れも高い。

【００２０】

【発明が解決しようとする課題】本発明は目的は従来のテーラードブランクが持つ長所を損なうことなく、下記の要求を満たすブランクおよびその製造方法を提供することにある。

【００２１】(a) 接合前部品の精度が要求されず、成形時に簡単なクランプで製造できる。

(b) 接合前部品の端部が非直線でも製造できる。

(c) 成形後の部品の強度特性、耐食性が優れている。

(d) 外板への適用が可能な、表面品質を有する。

【００２２】

【課題を解決するための手段】上記の目的を実現するために、発明者は鋭意検討を重ねた結果、以下の知見を得た。

【００２３】(a) 金属板同士を結合するのに点溶接は強度的に不十分で、成形性も低い。また耐食性がよくない。

【００２４】図３はスポット溶接と線溶接の比較を説明する模式図であり同図(a) はスポット溶接試片の側面図、同図(b) は線溶接の試片の側面図、同図(c) は線溶接でのプレス割れの模式図である。同図において図１～２と同一部品は同一符号で表す。試片の材料には０．８ｍｍと１．２ｍｍの冷延鋼板（ＳＰＣＣ）を用い、同図(a) および(b) に示すように、部分重ね方式でスポット溶接（ナゲット径：約４ｍｍ）およびレーザ溶接して試片を作成した。これらのブランクを直径５０ｍｍの球頭ポンチを用いて、張り出し試験により成形性を調査した。その結果、レーザ溶接による線溶接材は同図(c) に示すように、０．８ｍｍの母材内で破断したのに対し、スポット溶接による点溶接材は溶接部で破断した（図示せず）。また、限界張り出し高さは、レーザ溶接材では約３５ｍｍ、スポット溶接材では１０ｍｍであり、線溶接の方が成形性に優れることがわかった。

【００２５】また、線溶接はスポット溶接のような金属板の波打ちがないため、金属板間の隙間が小さく、水などの侵入が防止できるので耐食性が高い。とくにすみ肉溶接を行えば、金属板間の隙間がなくなり、耐食性は一層向上する。

【００２６】(b) シーム溶接の溶接線は直線状の制限があるが、レーザ溶接を用いれば、曲線化が可能であり、部品板接合の自由度が大きくなる。

【００２７】(c) ２枚以上の金属板を突き合わせるのではなく、面で重ね合わせ、その重なった部分の輪郭線近傍を溶接して金属板を結合するようにすれば、溶接前部品の打抜き加工の精度および溶接の位置決め精度はあまり高くなくてもよい。クランプ時の保持力もあまり大きくしなくてよい。

【００２８】線溶接は重なった部分の輪郭線の全周（外周）にわたって連続的に線溶接するのがよい。溶接強度が確保できるからであるが、部分的、断続的であってもよい。しかし、輪郭線上近傍を部分的、断続的に線溶接した場合、対角線上に相当する位置（輪郭線上の対向する部分）でも線溶接しておかないと、成形時または使用時に２枚の金属板のせん断ずれが大きくなる。

【００２９】輪郭線が非直線の場合はシーム溶接ができないが、短い直線部分のみをシーム溶接し、さらに金属板が重なった部分の輪郭線上の対向部分もシーム溶接することによって、強度を維持しつつ、安価なシーム溶接を使うことができる。

【００３０】(d) 外観を形成する金属板の内側に１枚の補強部材を重ねると、外観を形成する金属板を一体物として成形できる。これは、突合わせ溶接したブランクに比較して、外観性に優れる。とくに、線溶接の溶融痕が外側に出ないようにすると一層優れた外観が得られる。

【００３１】本発明は上記の知見に基づいて完成したもので、その要旨は以下の(1) から(4) にある。

【００３２】(1) 重ねられた２枚以上の金属板が、重なった部分の輪郭線近傍で線溶接によって結合され、該輪郭線上の該線溶接部に対向する部分の近傍で少なくとも１個所線溶接によって結合されていることを特徴とする一体化成形用ブランク。

【００３３】(2) 線溶接がすみ肉溶接であることを特徴とする前記(1) 項に記載の一体化成形用ブランク。

【００３４】(3) 重ねられた金属板の外側面の少なくと

も１面に線溶接起因の溶融部がないことを特徴とする前記(1) または(2) 項に記載の一体化成形用ブランク。

【００３５】(4) ポンチおよびダイを用いて行うプレス成形において、前記(3) 項に記載の一体化成形用ブランクを、線溶接起因の溶融部のない面をダイ側にして成形することを特徴とするブランクの一体化成形方法。

【００３６】ここで、本発明にいう２枚の金属板が「重なっている」状態とは、図１(b) のマッシュシーム溶接のように溶接線近傍のみで２枚の金属板が線状に重なっている状態ではなく、金属板同士が被成形面の一部または全部の範囲にわたって面状に重なっており、重なった部分が２次元的に広がった輪郭線を形成し、プレス成形時にはこれらの金属板が重なりあった状態のまま一体で成形されるものであることを意味する。また、「該線溶接部に対向する該輪郭線上の部分」とは、輪郭線が正多角形・長方形などの単純な形状の場合は対角線上の部分である。一般図形では、図７の説明で後述するように、ある溶接線部分に対して、成形中および／または成形部品の使用中に、重なった金属板間に作用するせん断応力が対応し、互いに逆方向で双方がバランスする関係にある部分をいう。

【００３７】

【発明の実施の形態】本発明の一体成形用ブランクは２枚以上の金属板が重ねられ、重なった部分の輪郭線近傍で線溶接によって接合され、該輪郭線上の該線溶接部分が対向する部分も線溶接によって接合されている。

【００３８】溶接がスポット溶接のような点溶接であると、成形時に溶接点に荷重が集中し、割れが生じやすくなるからである。また、成形できても部材の強度ばらつきが大きく信頼性が低下する。点溶接でも打点数が多くなると一点あたりの負荷荷重が小さくなり、上記のような問題は改善されるが、打点数が増えることは施工上非効率的である。

【００３９】図４は本発明に係るブランクの溶接部付近の状態を示す模式図で同図(a) はレーザ溶接またはアーク溶接によるすみ肉重ね溶接の場合、同図(b) はレーザ溶接またはアーク溶接による代つき重ね溶接の場合、同図(c) はシーム溶接による代つき重ね溶接の場合である。同図において図１～３と同一部品は同一符号で表す。また、本発明の詳細説明では図４(b) および(c) のように、金属板の重なった部分の輪郭線の内側を溶接する場合を「代つき」溶接という。

【００４０】同図(a) のようなすみ肉重ね溶接の場合は切断・打抜きの精度を高くし、溶接位置決めの精度を高くする必要があるが、クランプ装置は簡単な装置でもよく、耐食性向上の長所（後述）がある。

【００４１】一方、同図(b) または(c) のように代つき溶接として、同図に示す幅Wが３～１０ｍｍの範囲で許容すれば、切断・打抜きの精度も溶接位置決め精度もさほど高くする必要がなく、クランプ装置も簡単な装置で製造可能である。

【００４２】図５は本発明に係るブランクの材料の金属板を重ねる方法を示す模式図であり同図(a) は完全重ね方式、同図(b) は部分重ね方式、同図(c) は端面揃え重ね方式の場合である。同図において図１～４と同一部品は同一符号で表す。

【００４３】本発明の重ね方式は同図(a) ～(c) のいずれでも良い。同図(a) に示す完全重ね方式ではいずれかの金属板が完全に他の金属板に接している。自動車部品の部分補強を目的としたものではこの方式が最も一般的である。

【００４４】同図(b) の部分重ね方式では、重なり部分の面幅５は２次元としての広がりを有し、金属板Ａ１と金属板Ｂ２とが同時に成形される。重なり部分の面幅５は部分的に狭い部分があってもよいが、全ての部分で狭い（例えば５ｍｍ未満）と、実質的に突き合わせ溶接となり、本発明の範囲外である。同図(b) の２枚の金属板の部分重ね方式はプレス成形部品になったとき、いずれかの重ね線が外側に出てくるので外装用の部品には好適ではない。

【００４５】同図(c) の端面揃え重ね方式は溶接前部品の切断・打抜き精度および端面を揃える位置決め精度および溶接の狙い精度が要求されるので本発明の長所が若干失われる。

【００４６】図６は３枚の金属板が重ね合わされている各種の状態を示す模式図で、同図(a) は完全重ね、同図(b) は部分重ね、同図(c) は端面揃え重ねの場合である。同図において図１～５と同一部品は同一符号で表す。符号３は金属板Ｃであり、図５の２枚重ねの金属板の構成に、さらに補強するための付加材に相当する。

【００４７】同図に示すように本発明においては金属板が３枚もしくはそれ以上が接合されていてもよい。また、本発明のブランクには、完全重ね、部分重ねおよび端面揃え重ねが混在してもよい。

【００４８】本発明の一体成形用ブランクは、金属板の重なった部分の輪郭線近傍で線溶接されており、この線溶接部に対向する該輪郭線上の部分の近傍で少なくとも１個所が線溶接によって結合されている。

【００４９】輪郭線上の対向する線溶接の位置とは、その位置で溶接されていると、ブランクの成形中、および／または同部品の使用中に付加される金属板間のせん断応力がバランスするような溶接位置同士をいう。

【００５０】図７は本発明の一体化成形ブランクにおける線溶接位置を例示した模式図であり、同図(a-1) はコの字成形前の一体化成形用ブランク、同図(a-2) はこれを成形したもの、同図(b-1) は張り出し成形前の一体化成形用ブランク、同図(b-2)はこれを成形したもの、同図(c-1) は補強板となる金属板Ｂの形状がＣ字型となった押し出し成形前の一体化成形用ブランク、同図(c-2) はこれを成形したものである。同図において図１と同一

部品は同一符号で表す。同図を用いて、本発明の輪郭線上で互いに対向する関係にある溶接線について説明する。

【００５１】図７(a-1) において、溶接線Ｘ～Ｚは金属板Ｂ２の輪郭線のやや内側にある。溶接線Ｘと溶接線Ｙとは輪郭線上で対向した位置にある。すなわち、同図(a-2)のように成形するとき、溶接線ＸとＹとは金属板間で溶接線方向のせん断応力を受けるが、互いにバランスする。使用状態では例えば、梁構造として同図(a-2)の上方から荷重を受ける負荷を受けるとき、溶接線ＸとＹとは同図左右方向に互いに逆方向のせん断応力を受けるため、両溶接線は対向した位置関係にある。しかし、同図(a-1) の溶接線Ｚは対向する位置に溶接線はない。本発明の一体化成形用ブランクでは、対向する位置で少なくとも１個所線溶接によって結合されていることを要件としているので、同図(a-1) の一体化成形用ブランクも本発明範囲に属する。しかし、仮にＹとＺの溶接線のみであれば、本発明の要件を満たさない。

【００５２】図７(b-1) の場合、すみ肉溶接された溶接線ＸとＹとが対向し、溶接線ＲとＳとが対向している。同図(b-2) のように張り出し成形をするには、円盤状の補強材の金属板Ｂ２の中心を対象軸にした溶接線を設けるのが望ましいからであるからである。

【００５３】図７(c-1) では溶接線Ｘに対して、溶接線ＹおよびＺとが対向している。また、溶接線Ｒに対しては、溶接線Ｓも溶接線Ｔも対向しているといえる。すなわち、対向する溶接線とは、必ずしも本数が１：１で対応するものではなく、成形時および／または使用時に互いに逆方向のせん断応力が負荷されバランスする部分が１：複数の対向関係もありうる。対向する溶接線同士の溶接線長さが等しくなくてもよいが、溶接線長さの差または比は±２０％以内で等しくするのが好ましい。

【００５４】本発明の一体化成形用ブランクでは、線溶接の位置は金属板の輪郭線近傍とする。すみ肉溶接は輪郭線上で溶接する。重ねレーザ溶接、重ねシーム溶接などで、溶接幅代をとる場合、輪郭線の近傍とは通常内側１０ｍｍ以内の部分である。

【００５５】溶接線の長さは長いほど好ましい。最小長さは接合部の形状、プレス時の変形様式により異なるので一概に決めることはできないが、発明者らが行った試験では、溶接長さが輪郭線の長さの５０％以上あれば、溶接部での破断が起きていない。このことから、溶接線の長さは重なった部分の輪郭線の長さの５０％以上の長さを確保するのが好ましい。また、完全重ね方式では重ねた金属板の周囲長さの５０％以上の長さとするのが好ましい。

【００５６】線溶接は一つの連続した溶接線でもよく、また、断続した溶接線でもよい。つまり、全溶接長が１００ｍｍとは１本の１００ｍｍの溶接線でも、１０ｍｍの溶接線が１０本ある場合でも良い。ただし、溶接線が断続していると、非溶接部分への塗料の回り込みが悪く、水が浸入した場合には重ね面内部から腐食が広がる恐れがあるので連続した溶接線の方が好ましい。

【００５７】本発明では対向する位置同士に溶接線があれば、そのほかに点溶接、線溶接があっても差し支えない。輪郭線の中の中央部で補強のため線溶接または点溶接を付加的に行ってもよい。

【００５８】本発明のブランクを製造する際の溶接法は線溶接であればどのような方法でもよく、抵抗溶接、溶融溶接いづれの溶接法でもよい。抵抗溶接としては円盤電極を用いた重ねシーム溶接があげられる。溶融溶接としては、ＭＡＧ溶接や炭酸ガス溶接のようなガスシールドメタルアーク溶接。ＴＩＧ溶接プラズマアーク溶接のようなガスシールド溶接。また、レーザビーム溶接や電子ビーム溶接があげられる。

【００５９】本発明のブランクで重ねシーム溶接のような抵抗溶接でも良好な表面品質を得ることは可能であるが、材料両面に電極が接触するため、電極による痕跡が残る場合がある。

【００６０】良好な表面を得るには、溶融溶接法では、入熱面の反対側（下側）の金属板の下面（裏面）が溶融しない条件（非貫通条件）で溶接するのが好ましい。溶融溶接で裏面が溶融しない条件で溶接すると、裏面側は熱影響によるテンパーカラーと称する変色が若干生じるが、塗装後は溶接の痕跡が全く表れない。

【００６１】この下面側を成形部品の外側にすれば、自動車外板部品にも適用可能である。一般的に、外板の外装面は金型のダイ側になるので、本発明での成形方法は、金型のダイ側をブランクの裏面とするのがよい。

【００６２】溶け込みの大きさは特に限定しないが、健全な継手強度が得られ、かつ裏面の溶融を避けるために、裏面側（下板）の板厚の２５～７５％程度の溶け込み深さをねらうのが好ましいと考えられる。

【００６３】このような溶接条件は例えば、冷延鋼板のレーザ溶接では、２枚の鋼板厚さが０．４～６．０ｍｍ（好ましくは０．６～３．０ｍｍ）、炭酸ガスレーザ出力１～１０ｋＷ、焦点径０．０１～１ｍｍ溶接速度１～１０ｍ／ｍｉｎとすれば、下側鋼板の板厚の２５～７５％程度が溶け込み、下面には溶融部がない状態が得られる。

【００６４】本発明のブランクの長所を最大にするにはすみ肉重ね溶接を用いるのが望ましい。図４(b) または(c) に示す代付き重ね溶接のように溶接代があると、エッジ部でプレス成形の金型を痛める危険がある。また、エッジ部は塗膜が乗りにくく、耐食性が劣る。さらに、金属板間のすきまに塗料が回り込みにくく、すきま部の耐食性も劣るためである。さらに、溶接代は部材の強度に対する貢献が小さく、重量増加の悪影響もある。

【００６５】これに対して、すみ肉重ね溶接とは、図３(a) に示すように重ねた金属板の端部を溶接する方法で

ある。すみ肉溶接では金属板の端面が溶融し、これと接する他の金属板も溶融して接合されるものである。すみ肉溶接の溶接部の盛り上がりは、通常元の金属板の厚さ以下であるため、プレス成形時、金型に疵を付けにくいので好ましい。あるいは、ＭＡＧ溶接やＴＩＧ溶接の場合は溶接金属が金属板の輪郭線に沿って供給され双方の金属板が接合される。溶接条件によっては供給された金属が金属板の厚さ以上に盛り上がり、金型を傷つけたり、成形品に圧痕をもたらしたりするので要注意である。すみ肉重ね溶接においても裏面が溶融しない条件で溶接することが望ましい。

【００６６】

【実施例】（実施例１）炭酸ガスレーザ溶接を用いた従来法の突き合わせ溶接によるブランクと、本発明の重ね溶接によるブランクを多数に試作し、その不良率を調べた。

【００６７】図８は本実施例１の試験片の形状を示す概要図で、同図(a) は平面図、同図(b) 従来例の場合の側面図、同図(b) は本発明例の場合の側面図である。同図において図１～６と同一部品は同一符号で表す。同図(a) に示すように従来例の試験片は０．８ｍｍと１．６ｍｍの冷延鋼板を突き合わせ溶接した。切断面はシャーリングマシンにて切断した面である。

【００６８】一方、同図(b) に示すように本発明例の重ね溶接によるブランクは０．８ｍｍの冷延鋼板上に０．８ｍｍの冷延鋼板を重ね、その重ね部をすみ肉溶接した。溶接条件はいずれも出力３ｋＷ、溶接速度は５ｍ／ｍｉｎである。

【００６９】本発明例および従来例の試験片をそれぞれ１００個作成し、溶接部を外観観察して不良品数を調べた。

【００７０】図９は試験片のレーザ溶接結果の外観を示す模式図であり、同図(a) は突合わせ溶接の未架橋不良の場合、同図(b) は突合わせ溶接のアンダカット不良の場合、同図(c) は突合わせ溶接の良品の場合、同図(d) は重ね溶接の良品の場合である。同図(a) の未架橋および同図(b) のアンダカットを不良として数えた。

【００７１】溶接試験の結果、従来例のブランクでは３７％のアンダーカットおよび６％の未架橋が生じた。一方、本発明例では不良の発生は皆無であった。

【００７２】（実施例２）非直線の溶接線をもつブランクの溶接試験を行った。図１０は円状の溶接線をもつ試験片の形状を示す概要図であり、同図(a) は平面図、同図(b) は従来例の突合わせ溶接の場合の側面図、同図(c) は本発明例の重ね溶接の場合の側面図である。同図において図１と同一部品は同一符号で表す。

【００７３】同図(a) に示すように、従来例の試験片は０．８ｍｍおよび１．６ｍｍ厚の冷延鋼板をパンチにより円盤状の金属板Ｂ２を打ち抜き、開口部のある金属板Ａ１はめ込んで溶接をした。

【００７４】本発明例の試験片は０．８ｍｍ厚の冷延鋼板の金属板Ａ１と、０．８ｍｍ厚の円盤状の金属板Ｂ２を重ね、すみ肉溶接した。従来例および本発明例とも、材料を位置決めジグで位置をセットした後、ＮＣテーブルを円形に動かして円溶接を行った。溶接条件は実施例１と同様である。これらの試験片をそれぞれ１０個作成した。

【００７５】溶接試験の結果、比較例では１０ヶともアンダカットが生じたのに対し、発明例では不良の発生は皆無であった。

【００７６】（実施例３）次に、ブランクの耐食性を調査した。図１１は耐食試験用の試験片の形状を示す概要図であり、同図(a) は従来例のレーザ溶接による突き合わせ溶接の場合の側面図、同図(b) は従来例のスポット溶接による重ね溶接の場合の側面図、同図(c) は本発明例のレーザ溶接による重ね溶接の場合の側面図であり、同図(c-1) は代付き重ね溶接で溶融部が貫通している場合の側面図、同図(c-2) はすみ肉重ね溶接で溶融部が貫通している場合の側面図、同図(c-3) はすみ肉重ね溶接で非貫通の場合の側面図を示す。これらの試験片には２０μｍの電着塗装を施し、表面と裏面の塩水噴霧試験行った。耐食性の評価はさび発生までの時間（日数）を指標とした。試験結果を表１に示す。

【００７７】同表に示すように従来例の試験片Ｎｏ．１（突合わせ溶接、図１１(a) に相当）では表面（溶接入熱側）裏面とも溶接部に腐食が発生した。溶接部は酸化物を完全には除去していないので、溶接起因による酸化物のため塗料皮膜の付着性を低め、耐食性が劣化したものと思われる。試験片Ｎｏ．２（スポット溶接、：図１１(b) ）の場合、重ね合わせの端面が短時間で腐食し、重ねた鋼板間にも赤錆が発生した。隙間には塗料回り込まず耐食性を劣化させたものと思われる。試験片Ｎｏ．３は（代付きレーザ溶接貫通、図１１(c-1) ：）本発明例ではあるが、表面は試験片Ｎｏ．２と同様、短時間で腐食した。表面端部の条件はＮｏ．２と同等のためである。試験片Ｎｏ．４はレーザすみ肉溶接貫通（図(c-2) ）であり、表面の耐食性はＮｏ．１～３よりも良好である。裏面の溶融部は熱影響を受けて酸化しており、耐食性はＮｏ．３より若干優れるものの十分ではなかった。試験片Ｎｏ．５はレーザすみ肉溶接非貫通（図(c-3) ）であり、表面溶接部の耐食性はＮｏ．４と同等であるが、裏面は溶接による溶融部がないため、耐食性が極めて良好であった。

【００７８】

【表１】

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試験番号	溶接方法	さび発生日数（腐食個所）		備考
		表面	裏面	
1	突合わせ レーザ溶接	5日 （溶接部）	5日 （溶接部）	従来例
2	スポット 抵抗溶接	1日 （端面）	7日 （溶接部）	従来例
3	代つき重ね レーザ溶接（貫通）	1日 （端面）	7日 （溶接部）	本発明例
4	すみ肉重ね レーザ溶接（貫通）	10日 （溶接部）	10日 （溶接部）	本発明例
5	すみ肉重ね レーザ溶接（非貫通）	10日 （溶接部）	100日以上 さび発生なし	本発明例

【0079】

【発明の効果】本発明によって安価なテーラードブランクが製造でき、また、切断線が非直線の材料にも適用可能である。さらに、本発明を適用して得られた成形品は耐食性・外観性にも優れ、自動車用外装材部品への適用が可能である。

【図面の簡単な説明】

【図1】突合わせ溶接によるテーラードブランクの溶接方式を示す模式図であり同図(a) はレーザ溶接、同図(b) はマッシュシーム溶接の場合である。

【図2】スポット溶接による一体成形用ブランクの溶接部の概要を示す模式図である。

【図3】スポット溶接と線溶接の比較を説明する模式図であり同図(a) はスポット溶接試片の側面図、同図(b) は線溶接の試片の側面図、同図(c) は線溶接でのプレス割れの模式図である。

【図4】本発明に係るブランクの溶接部付近の状態を示す模式図で同図(a) はレーザ溶接またはアーク溶接によるすみ肉重ね溶接の場合、同図(b) はレーザ溶接またはアーク溶接による代つき重ね溶接の場合、同図(c) はシーム溶接による代つき重ね溶接の場合である。

【図5】本発明に係るブランクの材料の金属板を重ねる方法を示す模式図であり同図(a) は完全重ね方式、同図(b) は部分重ね方式、同図(c) は端面揃え重ね方式場合である。

【図6】3枚の金属板が重ね合わされている各種の状態を示す模式図で、同図(a) は完全重ね、同図(b) は部分重ね、同図(c) は端面揃え重ねの場合である。

【図7】本発明の一体化成形ブランクにおける線溶接位置を例示した模式図であり、同図(a-1) はコの字成形前の一体化成形用ブランク、同図(a-2) はこれを成形した＊もの、同図(b-1) は張り出し成形前の一体化成形用ブランク、同図(b-2) はこれを成形したもの、同図(c-1) は補強板となる金属板Bの形状がC字型となった押し出し成形前の一体化成形用ブランク、同図(c-2) はこれを成形したものである。

【図8】試験片の形状を示す概要図で、同図(a) は平面図、同図(b) 従来例の場合の側面図、同図(b) は本発明例の場合の側面図である。

【図9】試験片のレーザ溶接結果の外観を示す模式図であり、同図(a) は突合わせ溶接の未架橋不良の場合、同図(b) は突合わせ溶接のアンダカット不良の場合、同図(c) は突合わせ溶接の良品の場合、同図(d) は重ね溶接の良品の場合である。

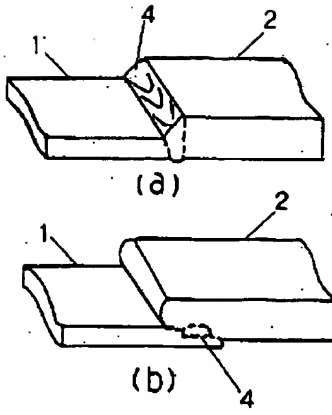
【図10】円状の溶接線をもつ試験片の形状を示す概要図であり、同図(a) は平面図、同図(b) は従来例の突合わせ溶接の場合側面図、同図(c) は本発明例の重ね溶接の場合の側面図である。

【図11】耐食試験用の試験片の形状を示す概要図であり、同図(a) は従来例のレーザ溶接による突き合わせ溶接の場合の側面図、同図(b) は従来例のスポット溶接重ね溶接の場合の側面図、同図(c) は本発明例のレーザ溶接による重ね溶接の場合の側面図であり、同図(c-1) は代付き重ね溶接で溶融部が貫通している場合の側面図、同図(c-2) はすみ肉重ね溶接で溶融部が貫通している場合の側面図、同図(c-3) はすみ肉重ね溶接で非貫通の場合の側面図を示す。

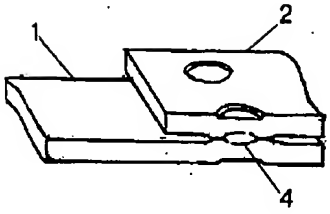
【符号の説明】

1：金属板A　　2：金属板B
3：金属板C　　4：溶接部
5：重なり部分の面幅

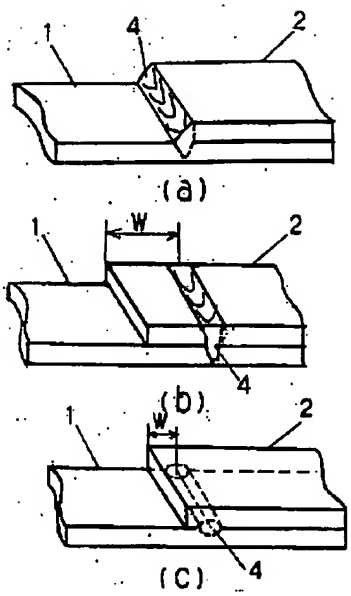
【図1】



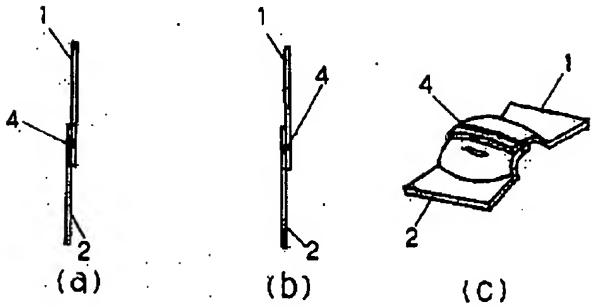
【図2】



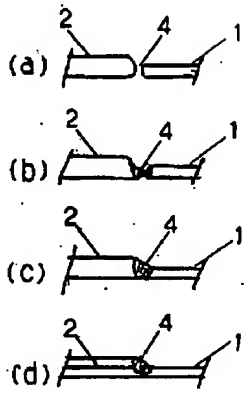
【図4】



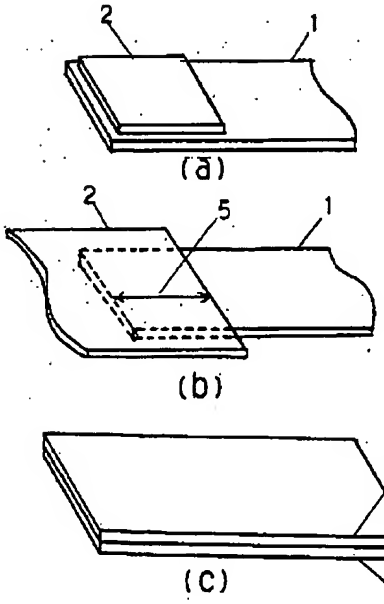
【図3】



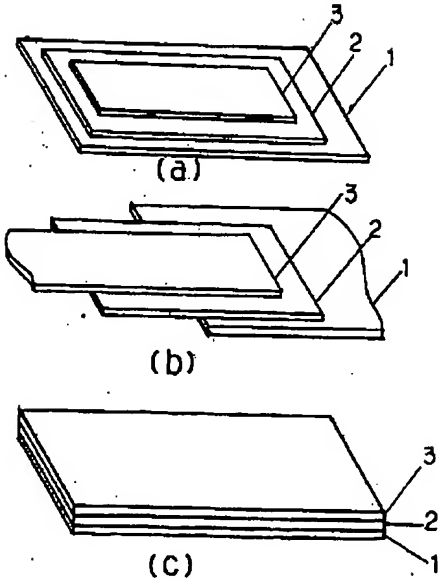
【図9】



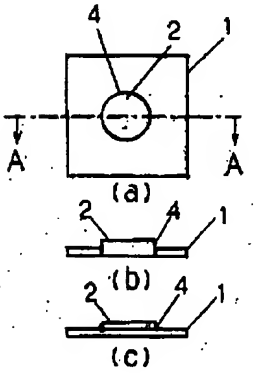
【図5】



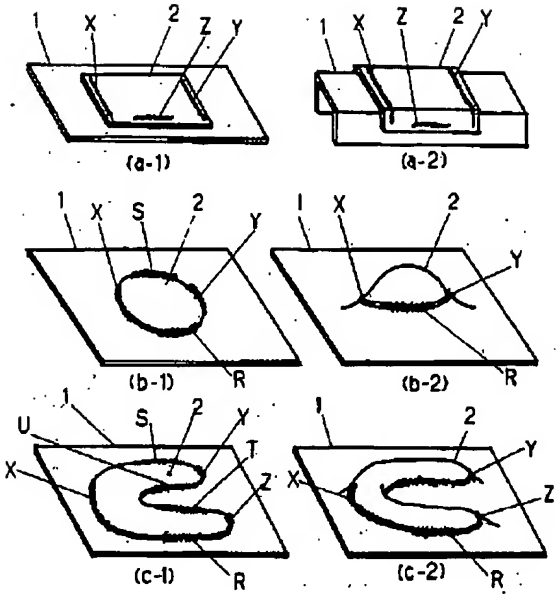
【図6】



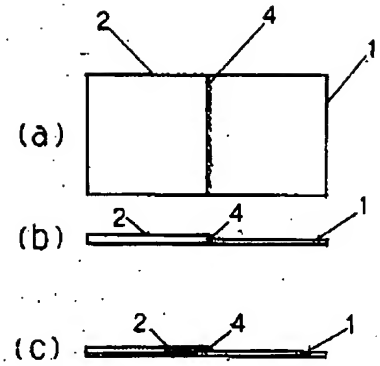
【図10】



【図7】



【図8】



【図11】